North American Drought: Paleoclimatic and Historic Contexts

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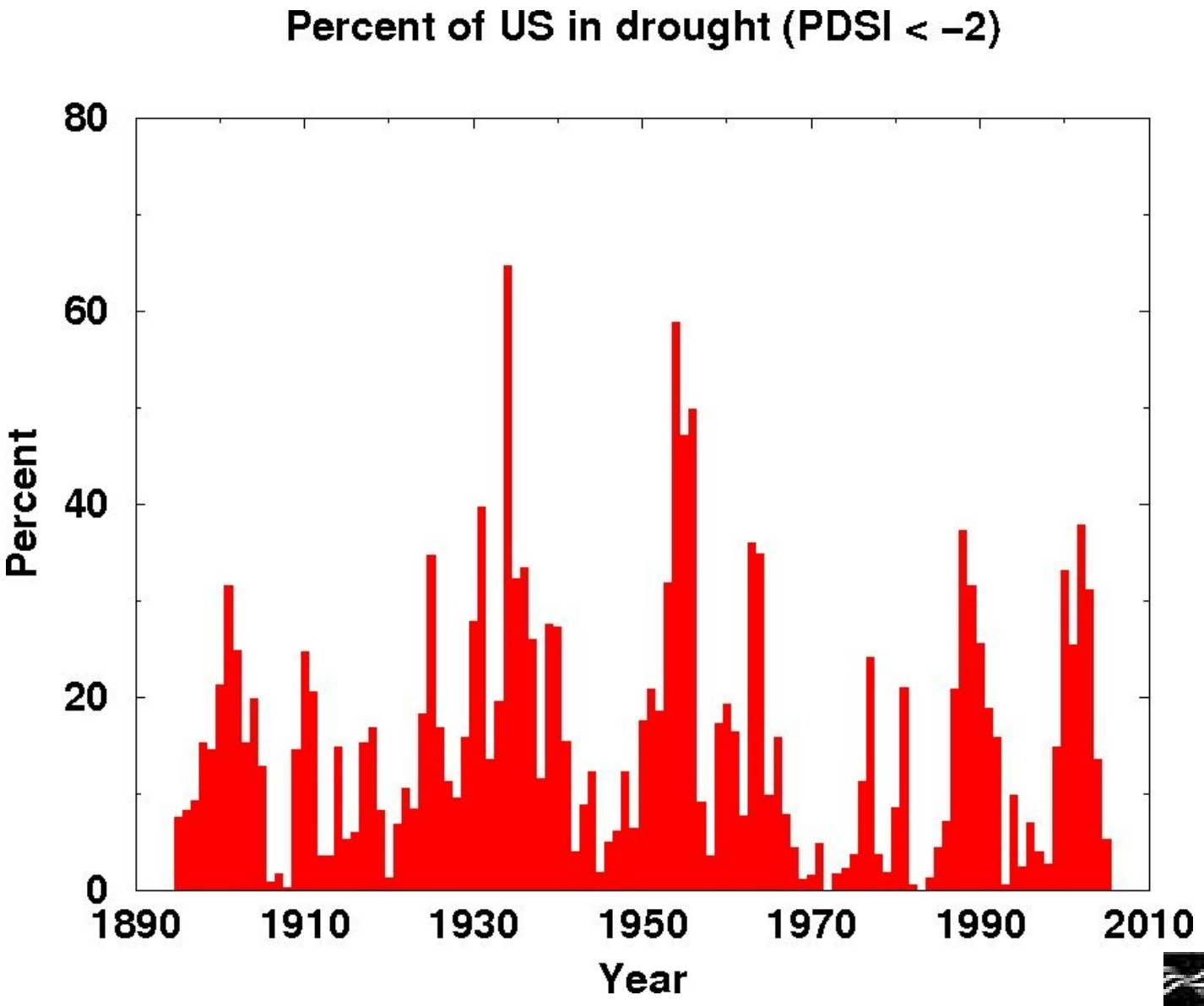
USGS, WRD, Denver, CO

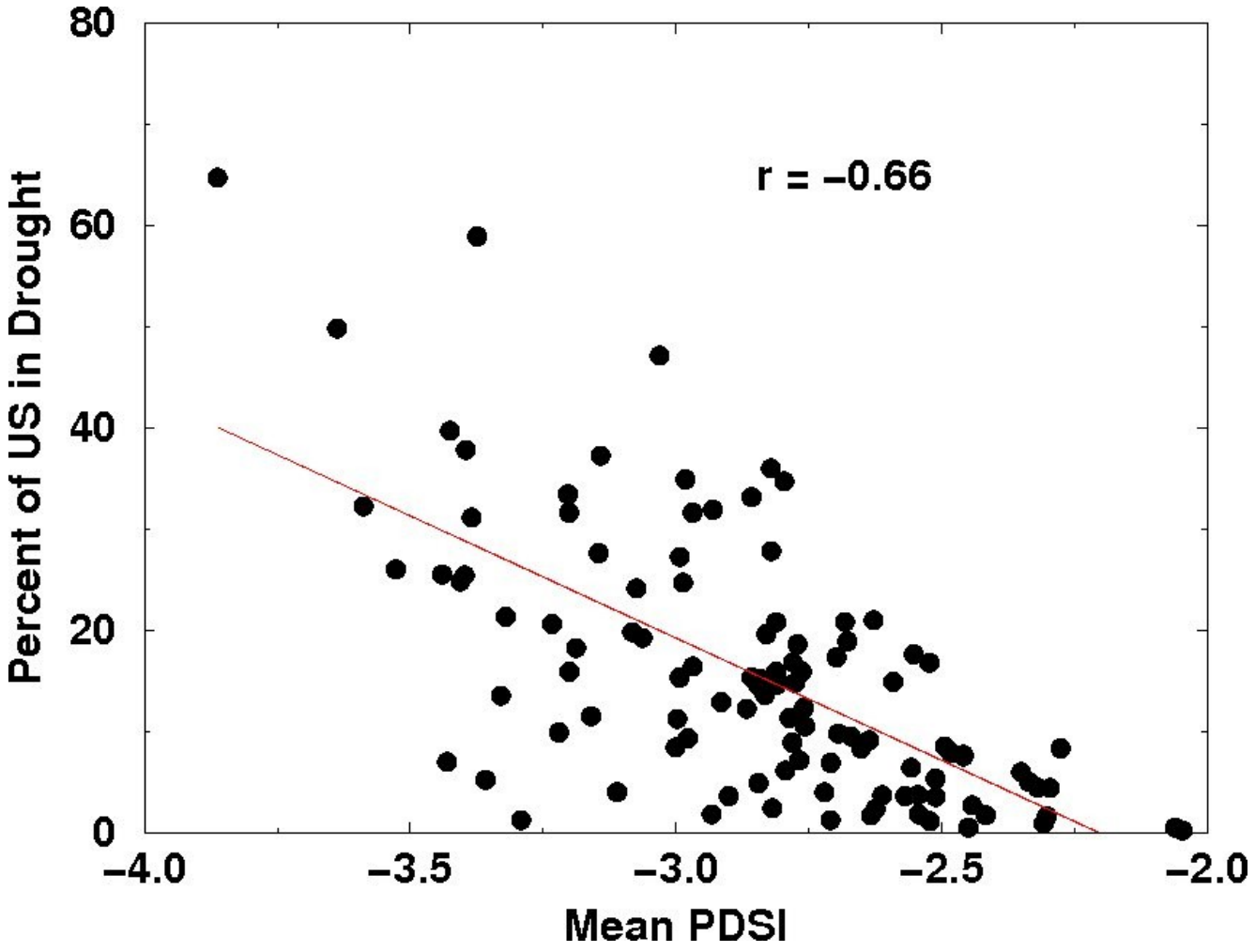
USGS

Drought occurs somewhere in the US almost every year and can occur over a large portion of the country.



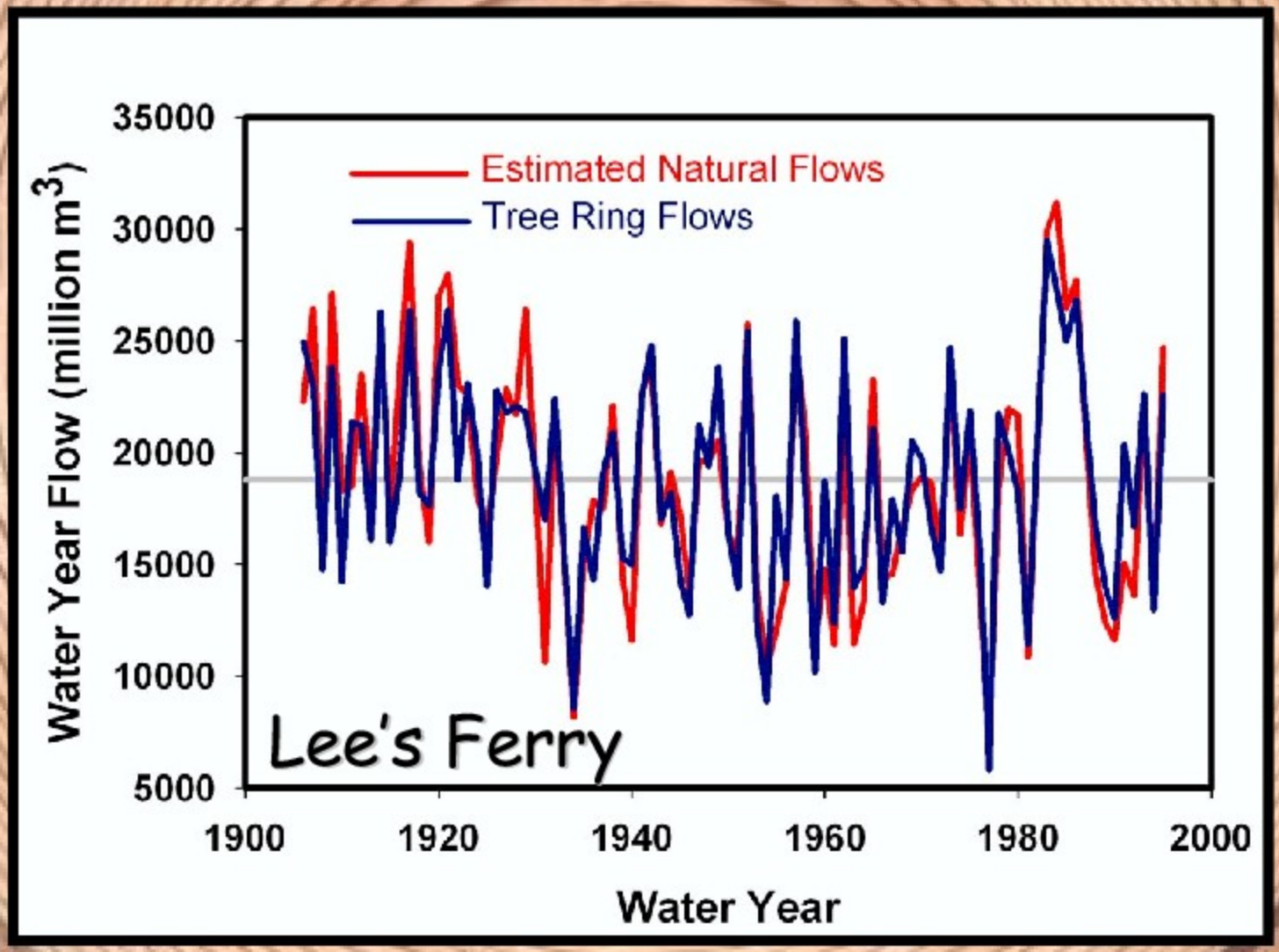
USGS

Generally, the most spatially extensive droughts are the driest droughts.



USGS

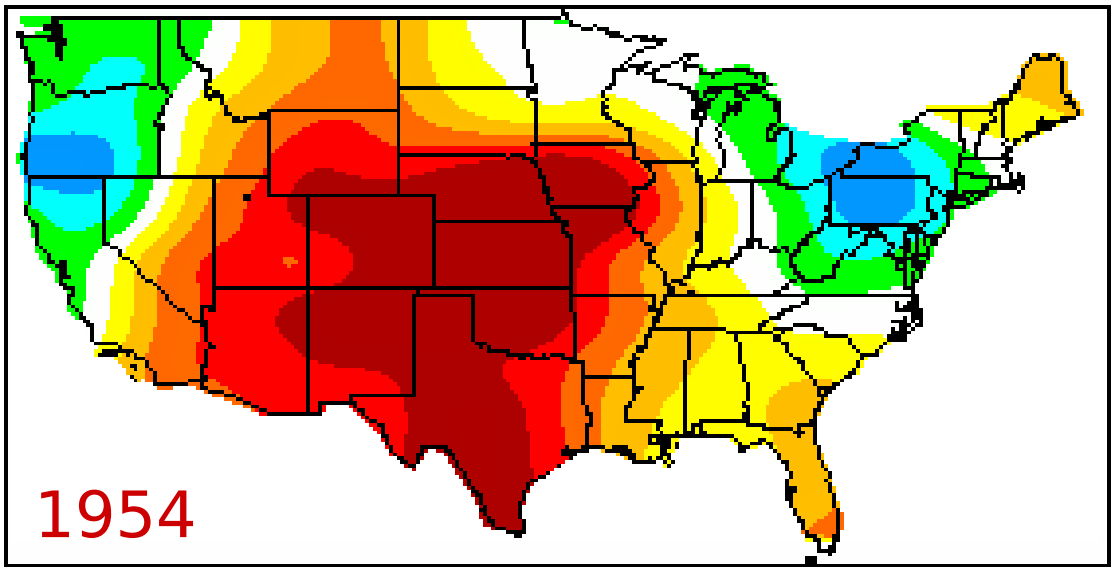
Tree rings capture both interannual and interdecadal variations in climate

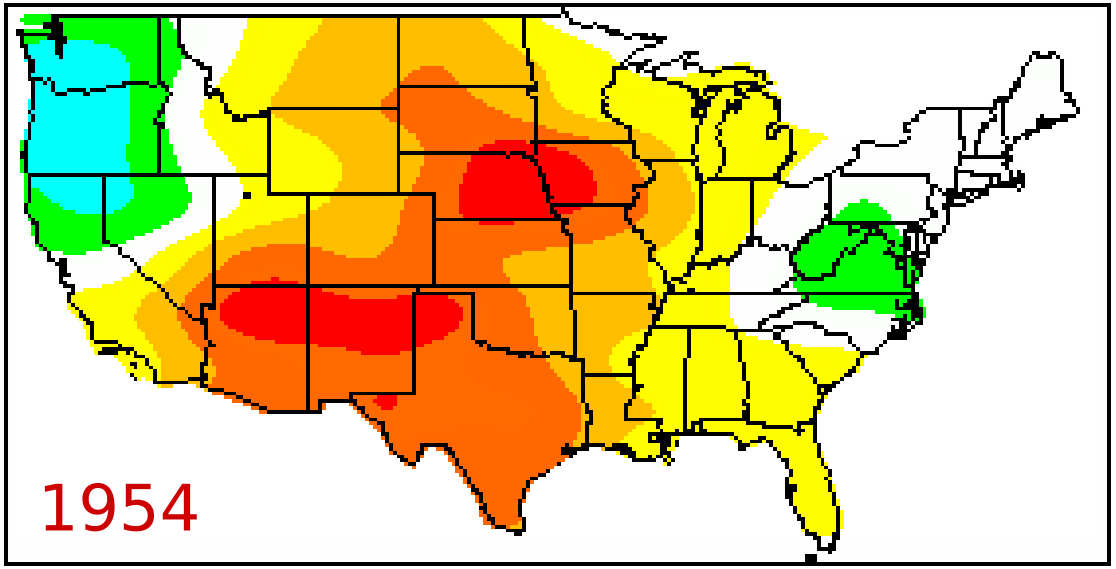


Courtesy of Stephen Gray

USGS

Tree rings also capture the spatial variability of climate

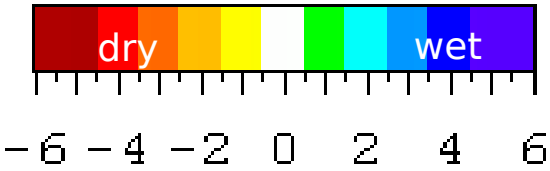




Source: NOAA Paleoclimate web page

Instrumental

PDSI



Tree-Ring

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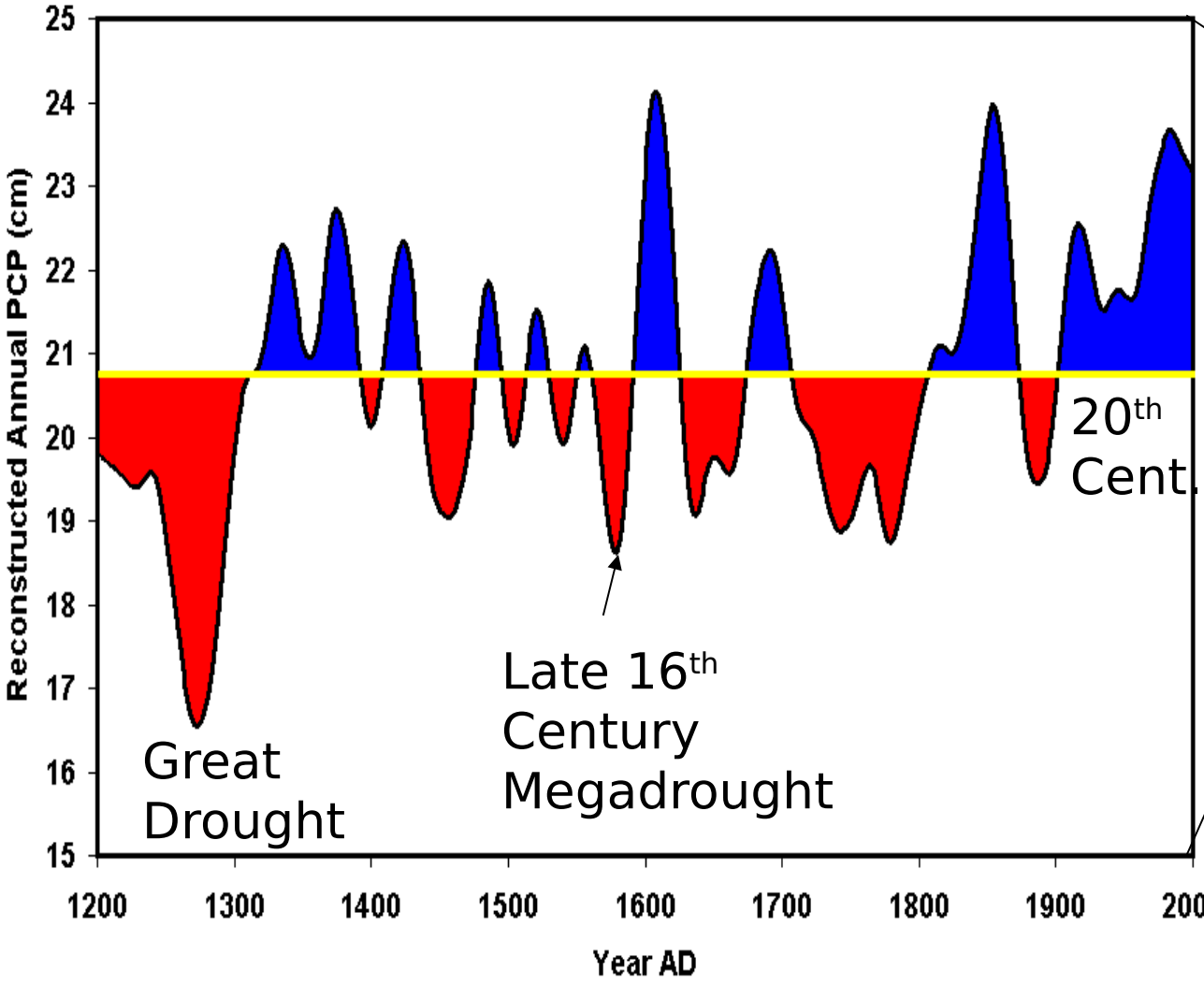
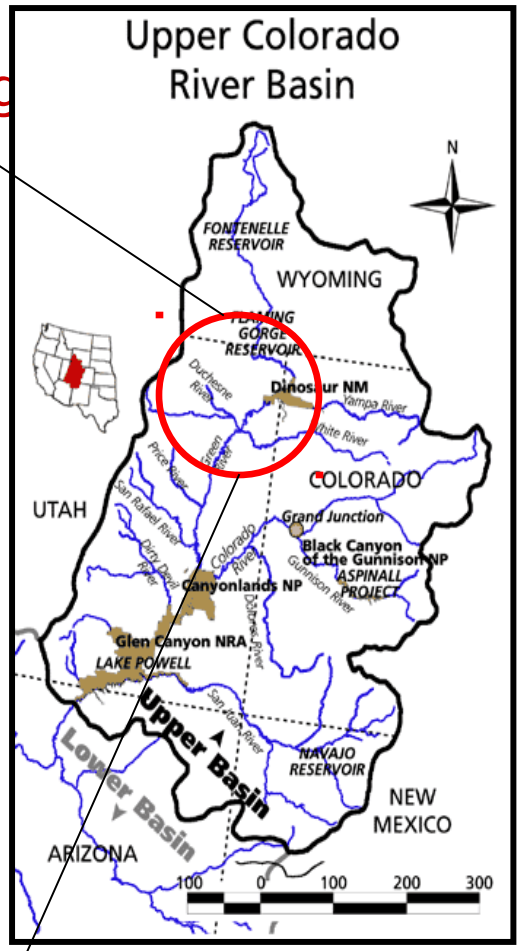
Why use climate reconstructions? The instrumental record may not include the full range of climate variability.

Uinta Basin Watershed: 50-yr Running Averag





Gray, Jackson, Betancourt (2004)

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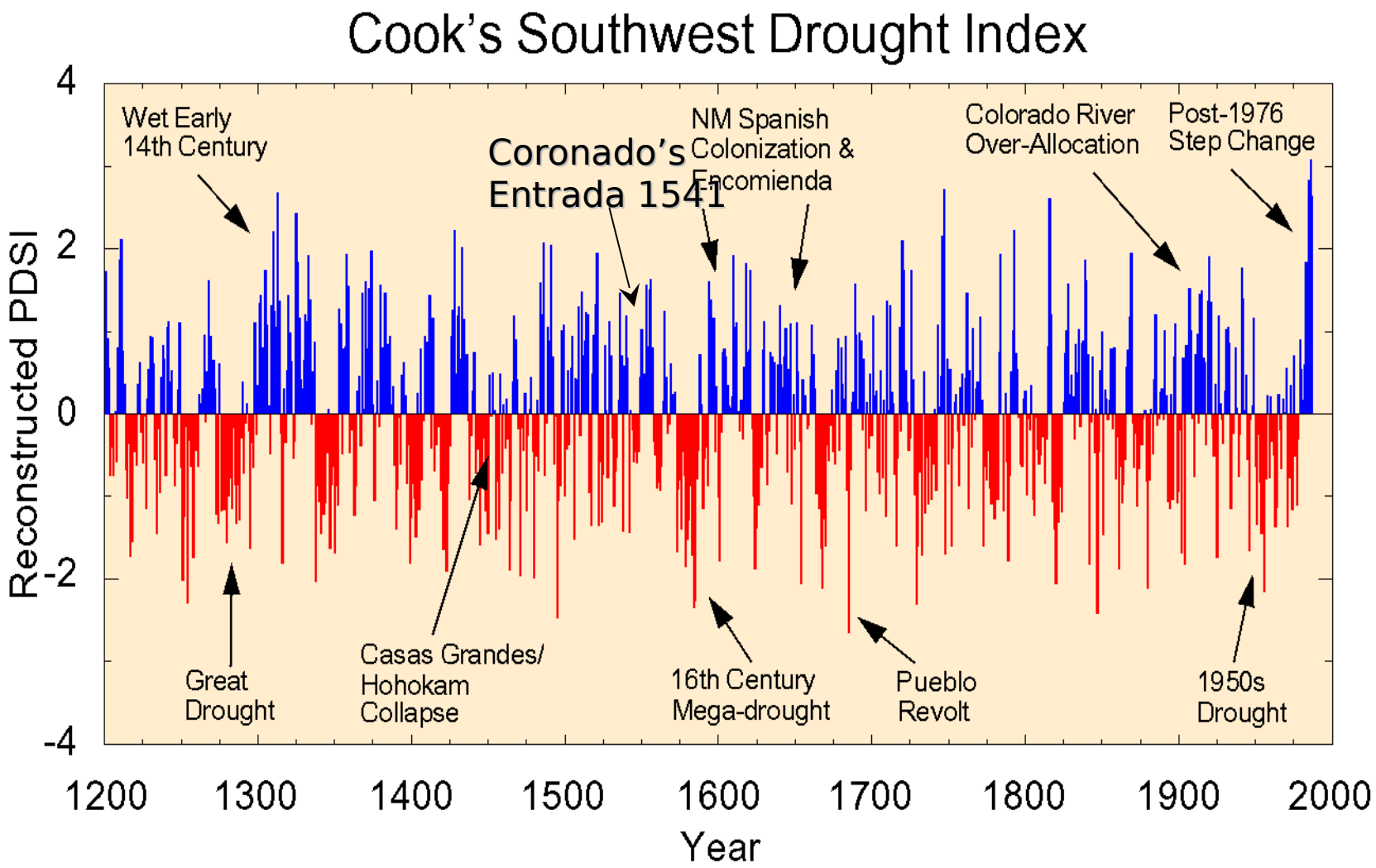
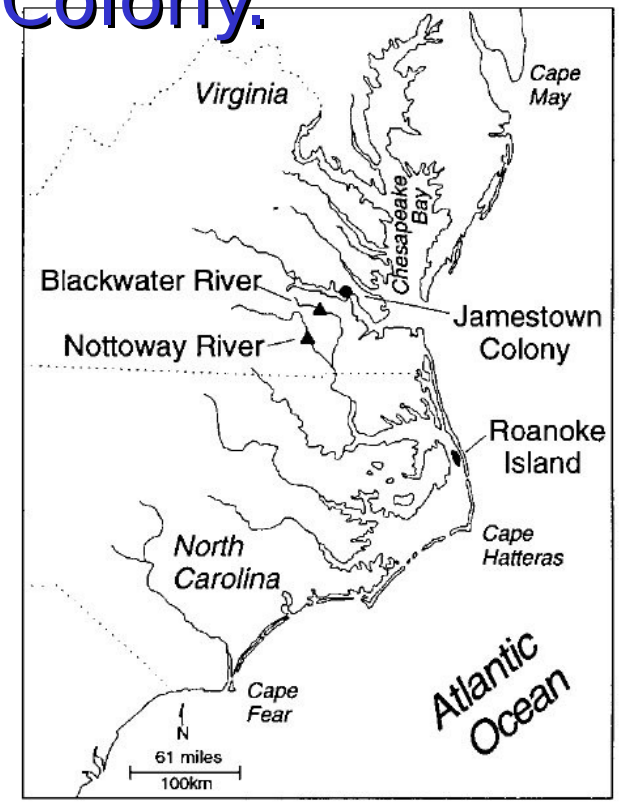
Persistent climate anomalies have had significant socio-economic impacts.

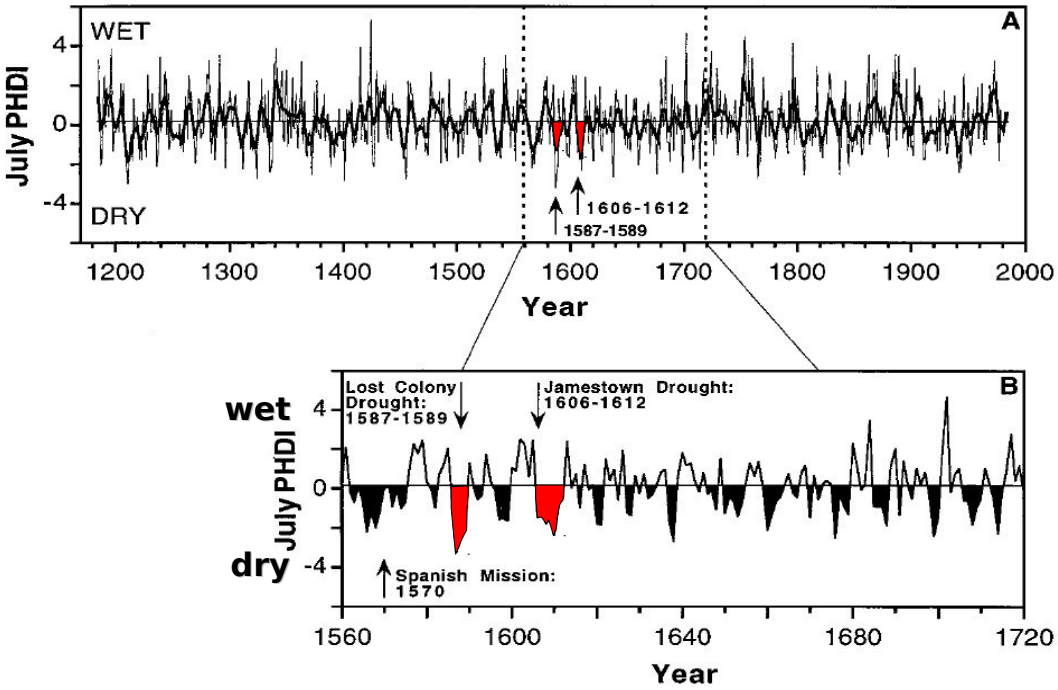


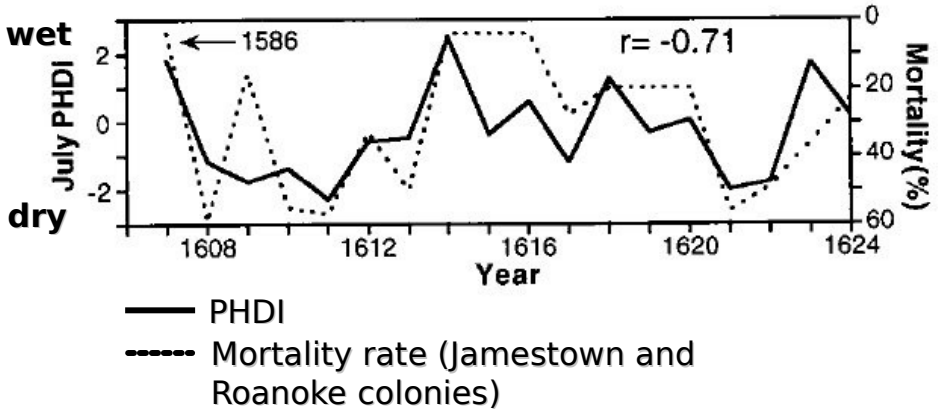
Significant Cultural Events

USGS

Drought may have been the cause of the lost Jamestown Colony.



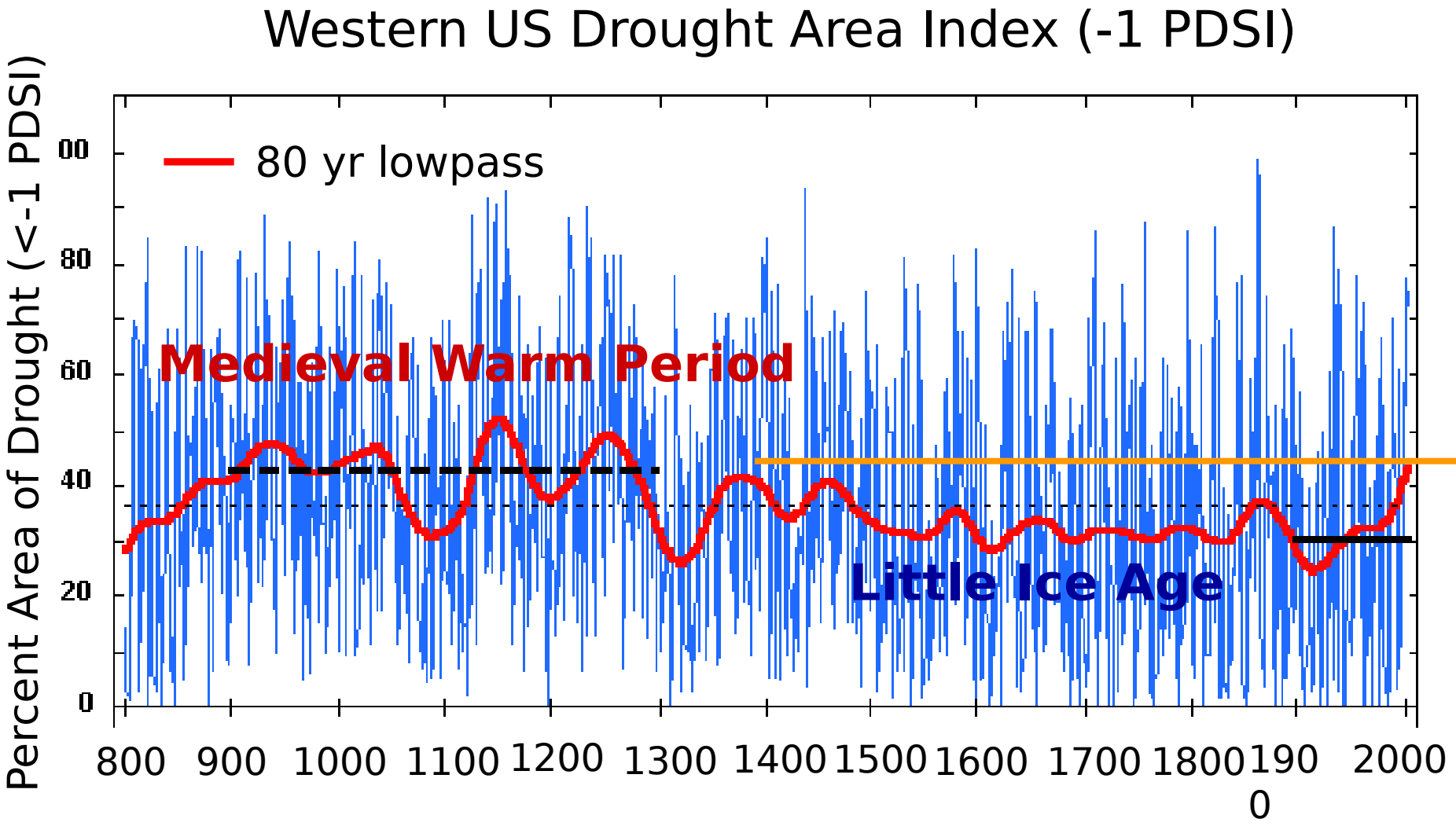




Stahle et al., Science, 1998

USGS

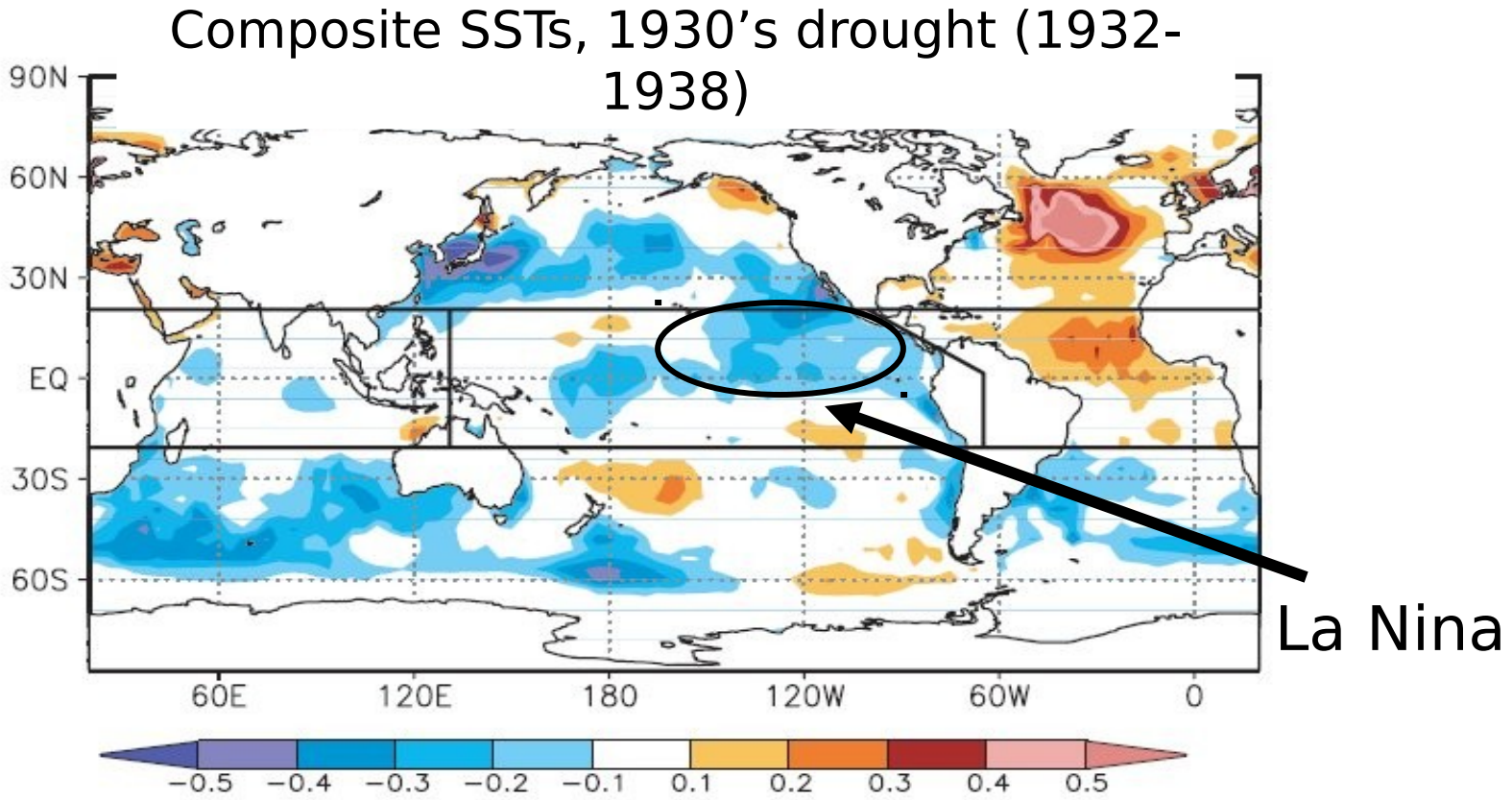
Current drought occurrence in the western U.S. is approaching that of the Medieval Warm Period.



Krusik & Cook (2004) North American Drought Atlas

USGS

There is instrumental and model evidence that La Nina is a significant cause of persistent drought in the U.S.

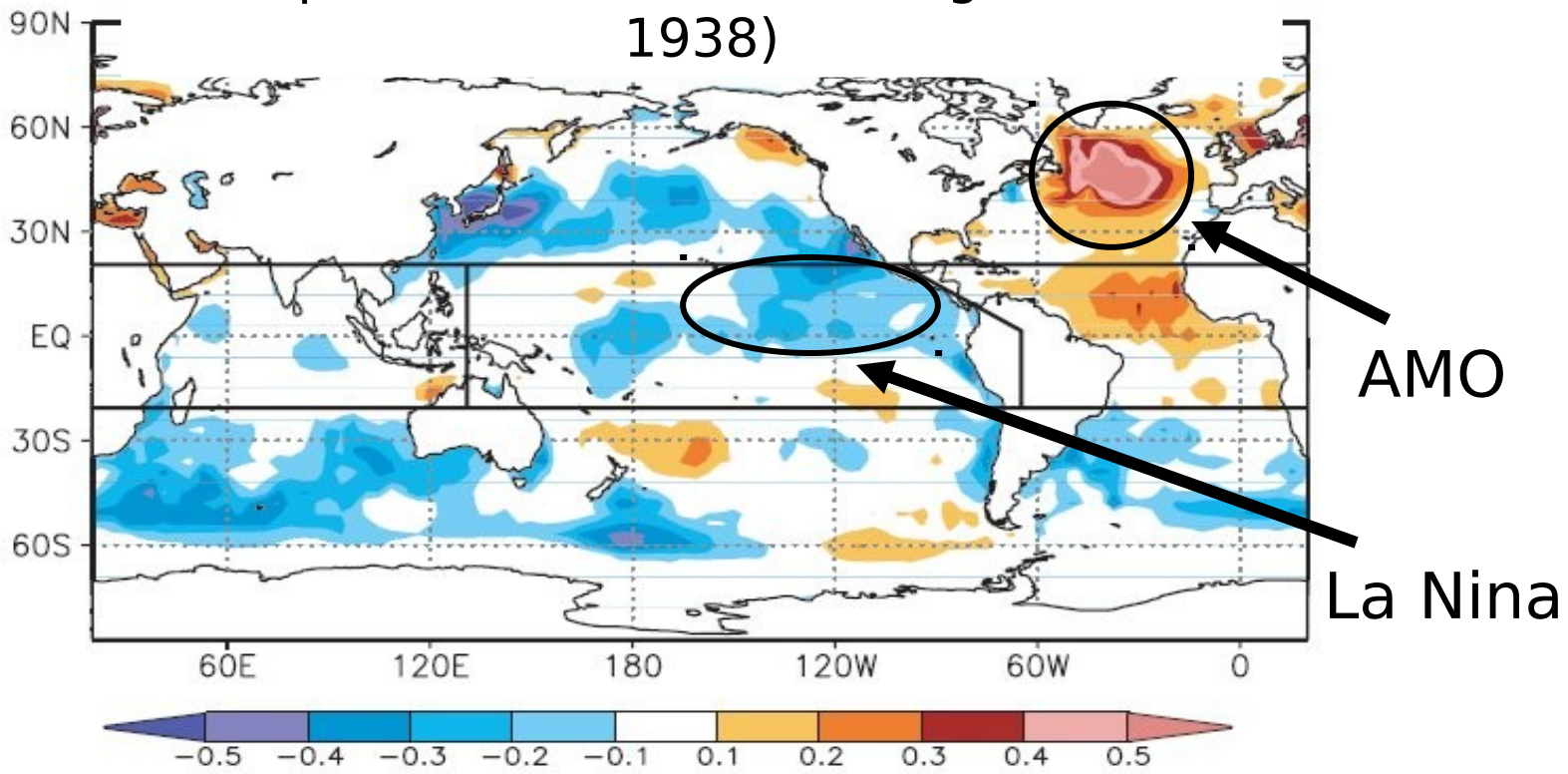


Schubert et al., Science, 2005

USGS

There is instrumental and model evidence that La Nina is a significant cause of persistent drought in the U.S. …but there also is a signal in the North Atlantic.

Composite SSTs, 1930's drought (1932-1938)

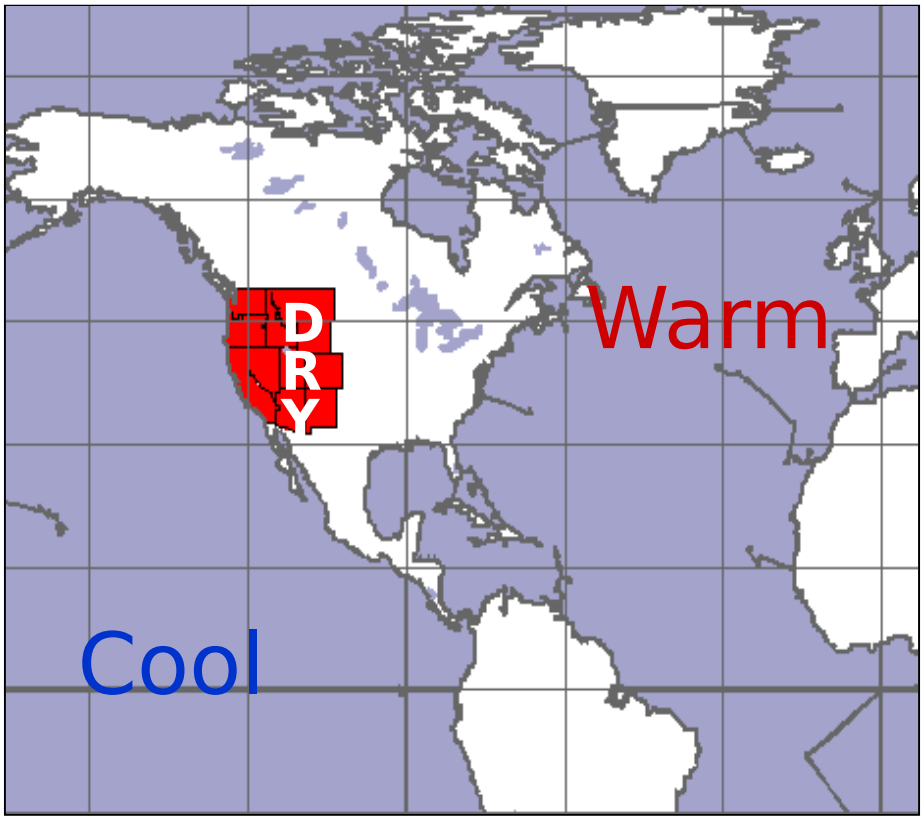


Schubert et al., Science, 2005

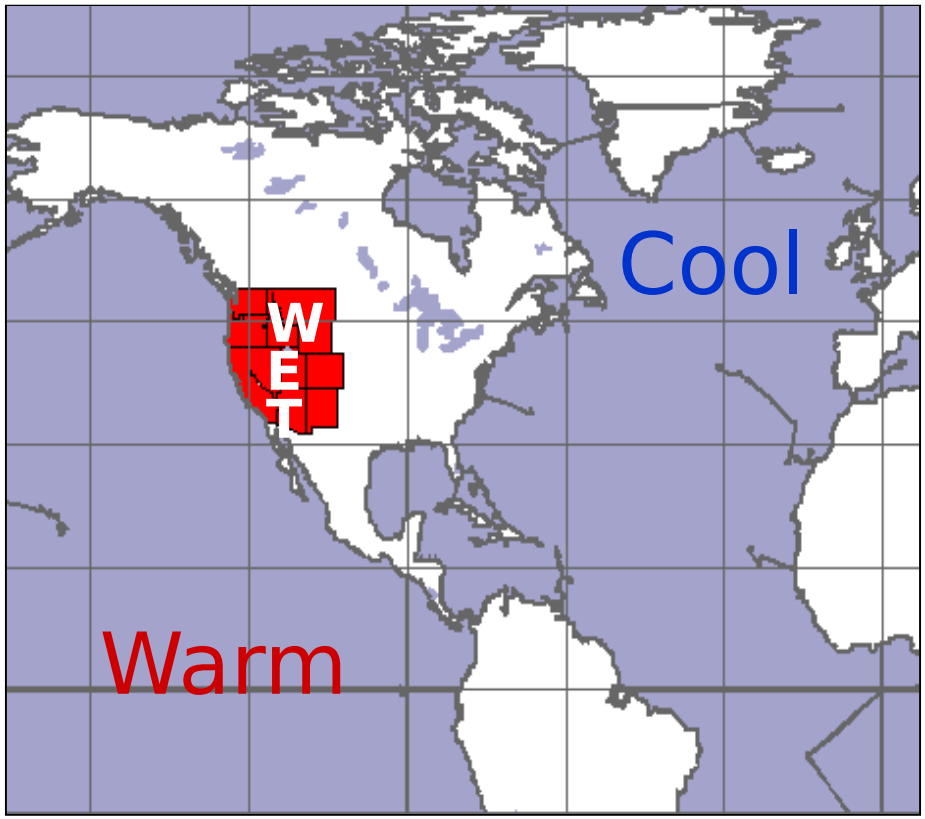
USGS

Interaction of Pacific and Atlantic SSTs also may govern centennial-scale trends in western U.S. drought.

Medieval Warm Period
AD 900-1300



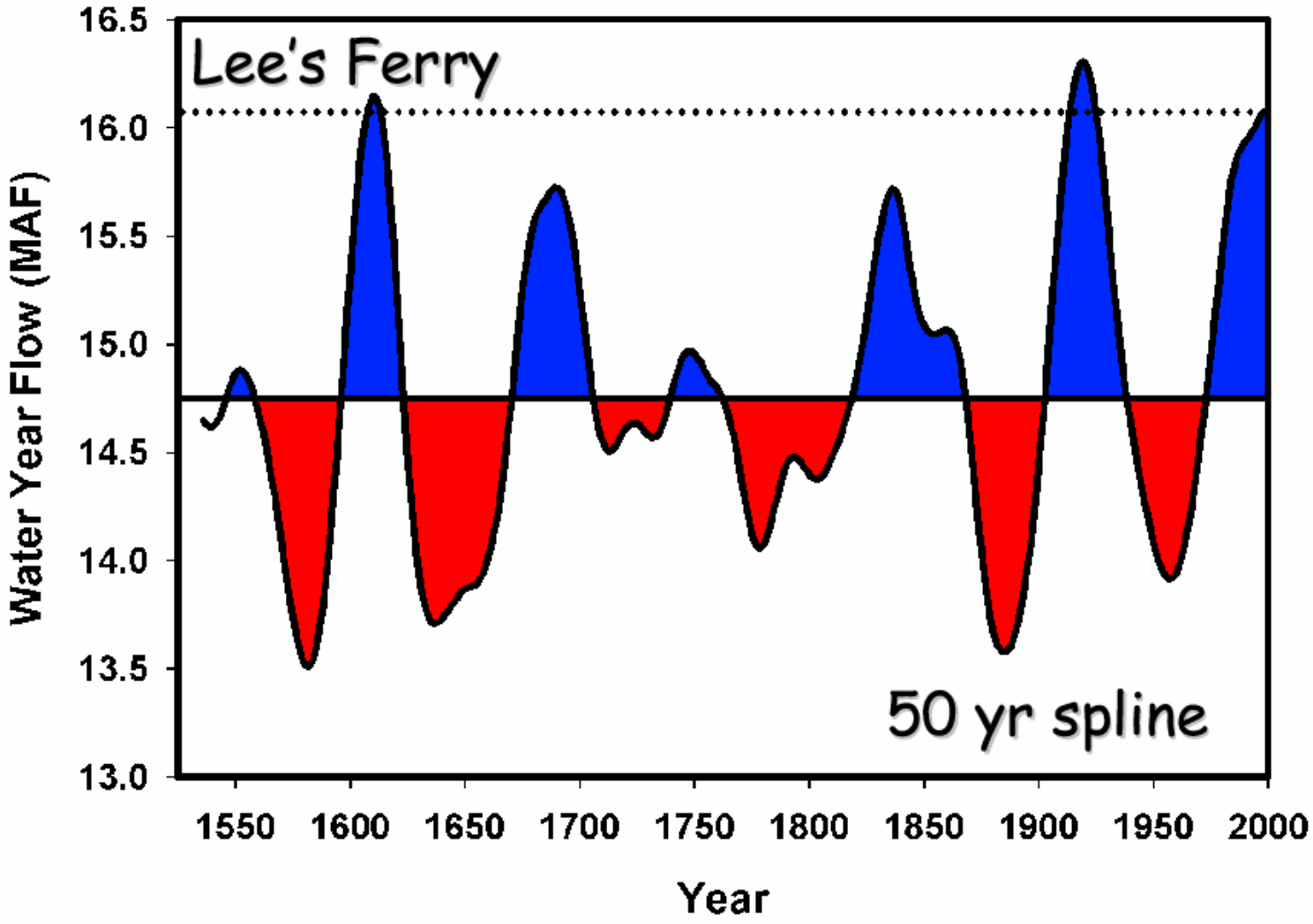
Little Ice Age
AD 1400-1850



USGS

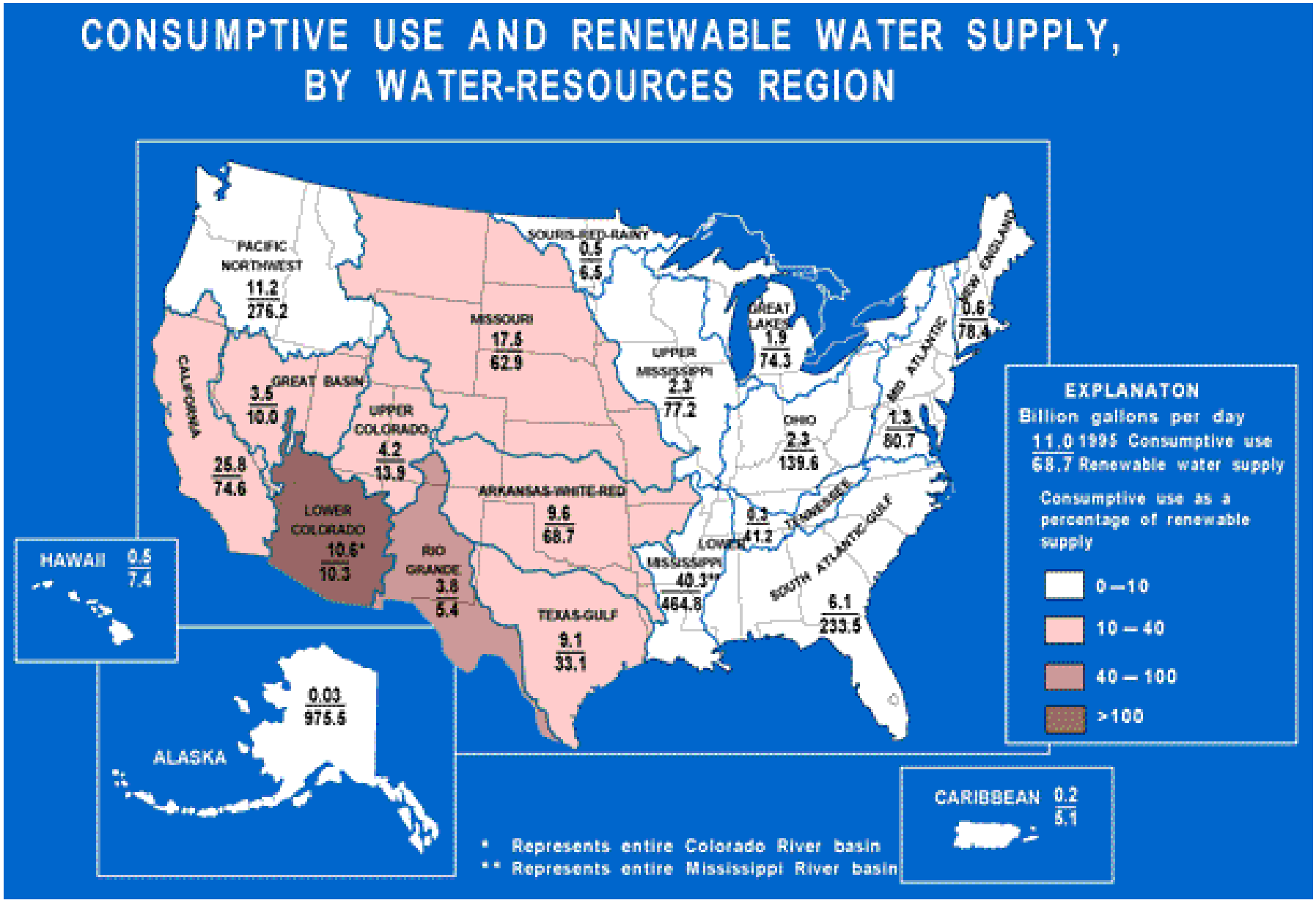
Courtesy Julio Betancourt

The 20th century included the wettest and 3rd wettest periods in the UCRB during the past 500 years



Source: Steve Gray, U. Wyo.

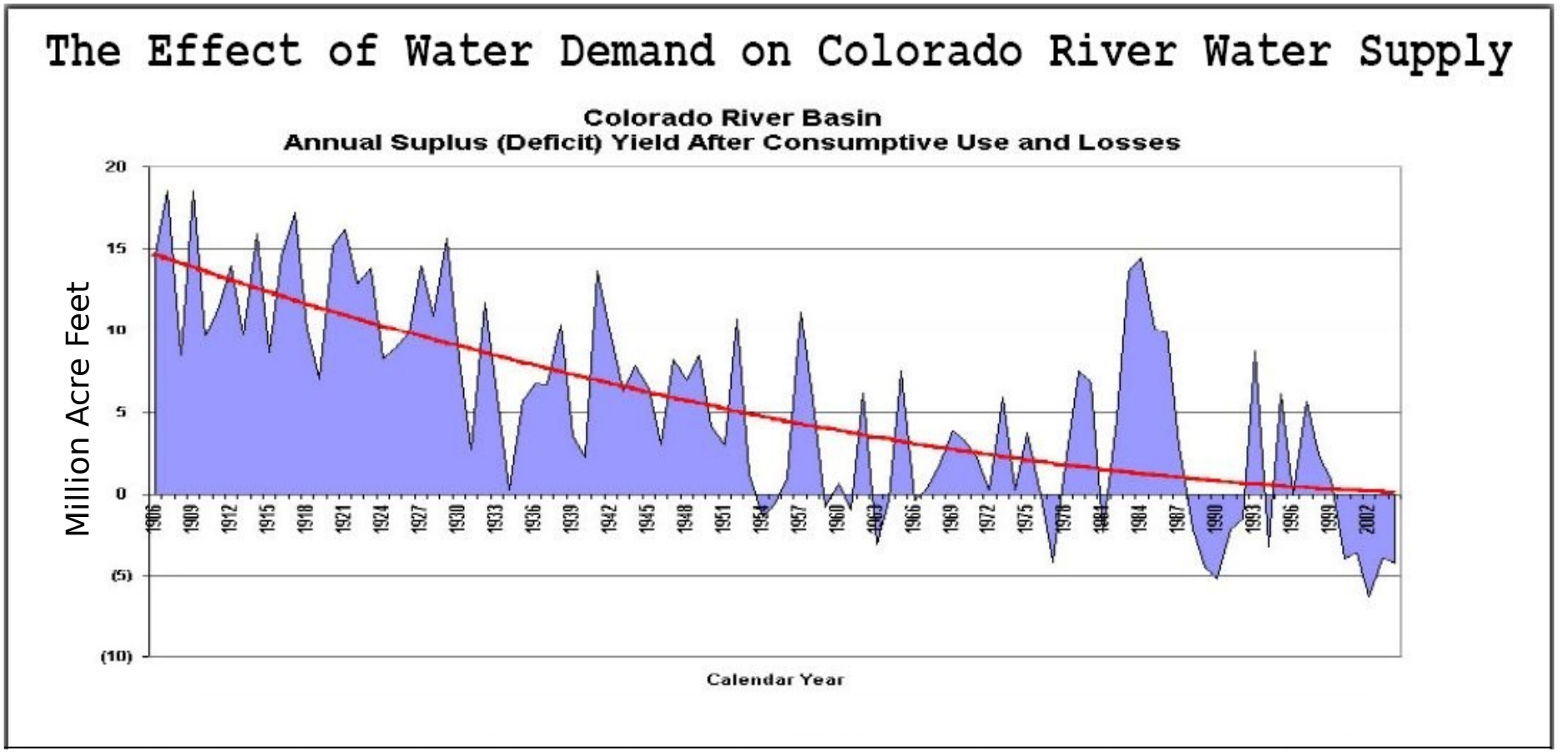
USGS


CONSUMPTIVE USE AND RENEWABLE WATER SUPPLY, BY WATER-RESOURCES REGION
PACIFIC NORTHWEST 11.2 / 276.2
CALIFORNIA 25.8 / 74.6
GREAT BASIN 3.5 / 10.0
UPPER COLORADO 4.2 / 13.9
LOWER COLORADO 10.6* / 10.3
RIO GRANDE 3.8 / 6.4
MISSOURI 17.5 / 62.9
SOURIS-RED-RAINY 0.5 / 6.5
ARKANSAS-WHITE-RED 9.6 / 68.7
TEXAS-GULF 9.1 / 33.1
UPPER MISSISSIPPI 2.3 / 77.2
GREAT LAKES 1.9 / 74.3
OHIO 2.3 / 139.6
TENNESSEE 0.3 / 41.2
LOWER MISSISSIPPI 40.3** / 464.8
SOUTH ATLANTIC-GULF 6.1 / 233.5
MID ATLANTIC 1.3 / 80.7
NEW ENGLAND 0.6 / 78.4
HAWAII 0.5 / 7.4
ALASKA 0.03 / 975.5
CARIBBEAN 0.2 / 5.1
EXPLANATON
Billion gallons per day
11.0 1995 Consumptive use
68.7 Renewable water supply
Consumptive use as a percentage of renewable supply
0—10
10—40
40—100
>100
* Represents entire Colorado River basin
** Represents entire Mississippi River basin

using 1995 estimates of water use

USGS

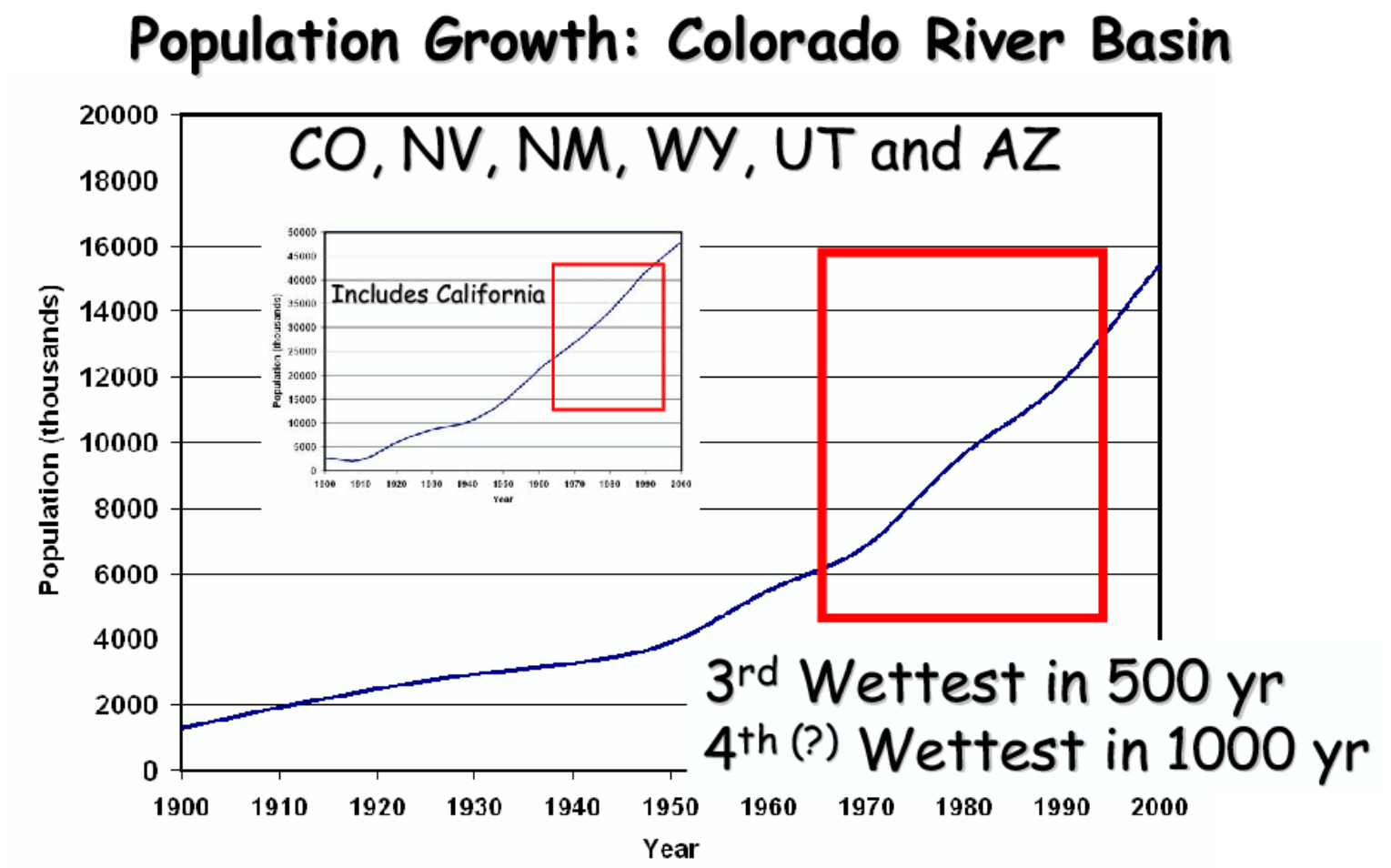
Increasing water demand is stressing the UCRB water supply, even during one of the wettest centuries.



Source: Glen Canyon Institute, March 2005

USGS

Population growth and water demand have increased dramatically in the UCRB during an anomalously wet period. What will happen when the climate is drier?

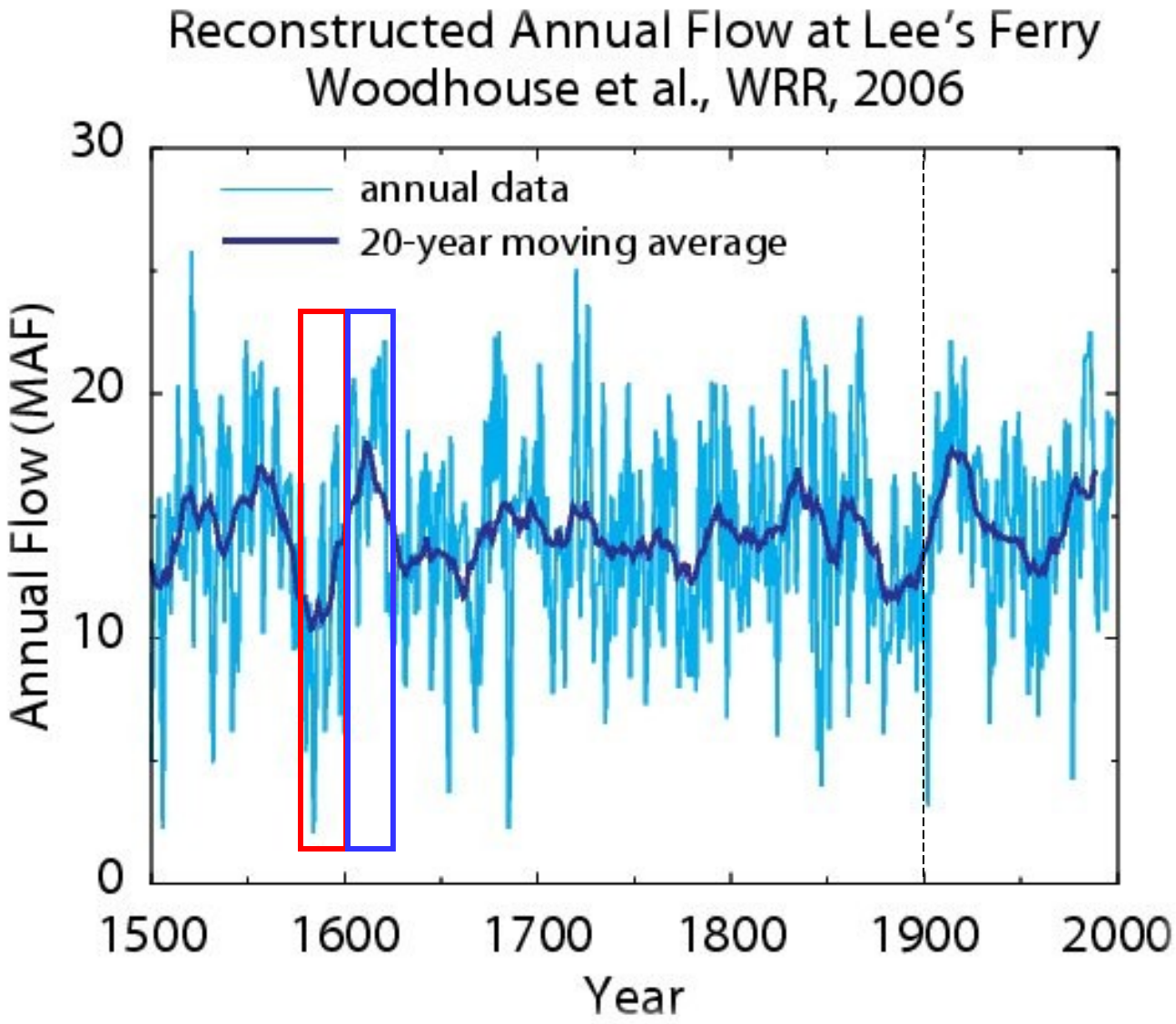

Population Growth: Colorado River Basin
CO, NV, NM, WY, UT and AZ
Includes California
Population (thousands)
Year
3rd Wettest in 500 yr
4th (?) Wettest in 1000 yr

Courtesy of Stephen Gray, U. Wyo.

USGS

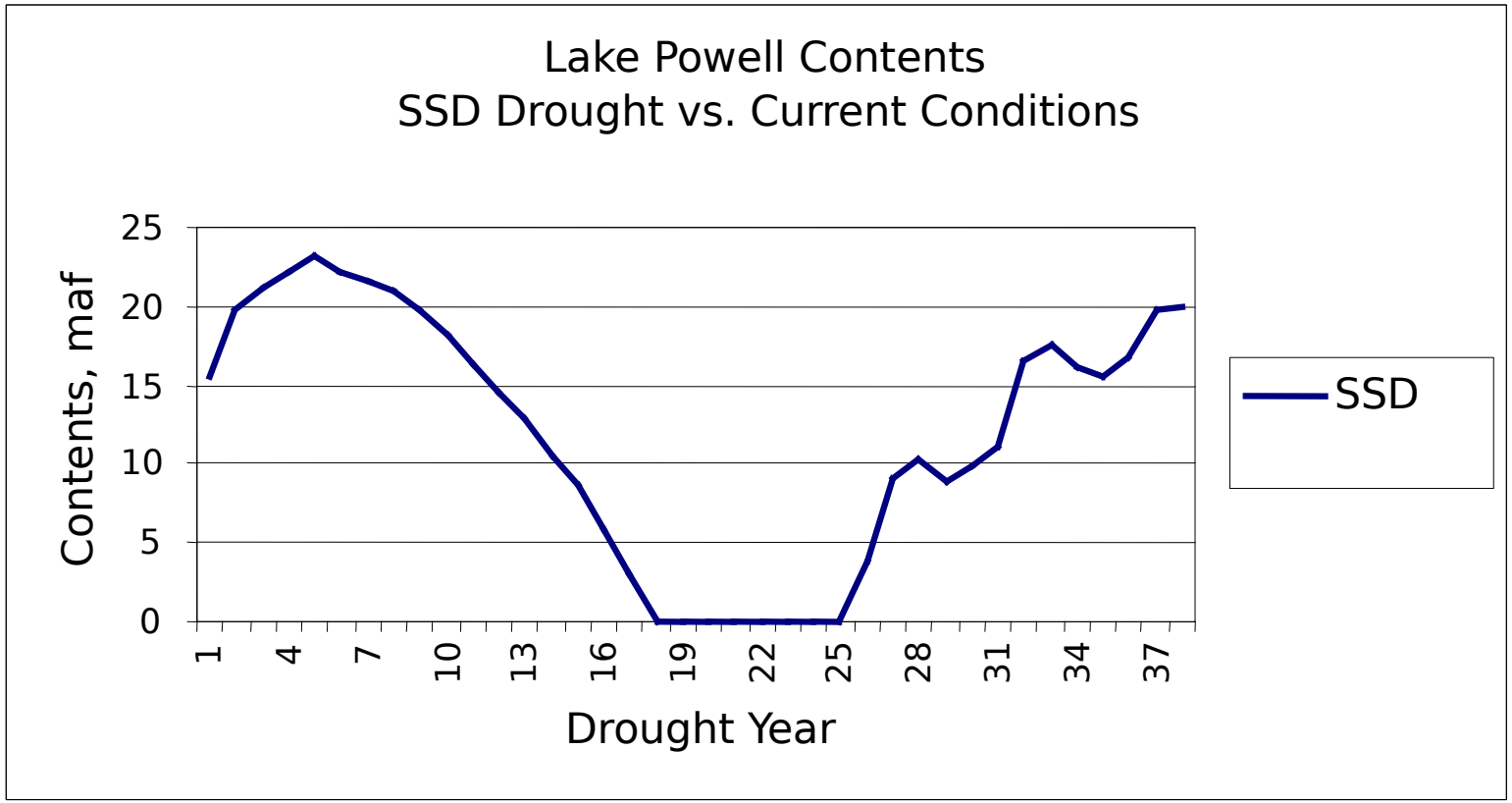
Severe-Sustained Drought (SSD) Experiments

Harding et al., WRB, 1995



USGS

Effects of Severe-Sustained Drought (dry regime) on Lake Powell



Based on 1579-1616 reconstruction of flow at Lees Ferry (1579-1600 drought, 1601-1616 recovery), 1992 water use.

Harding et al., WRB, 1995

USGS

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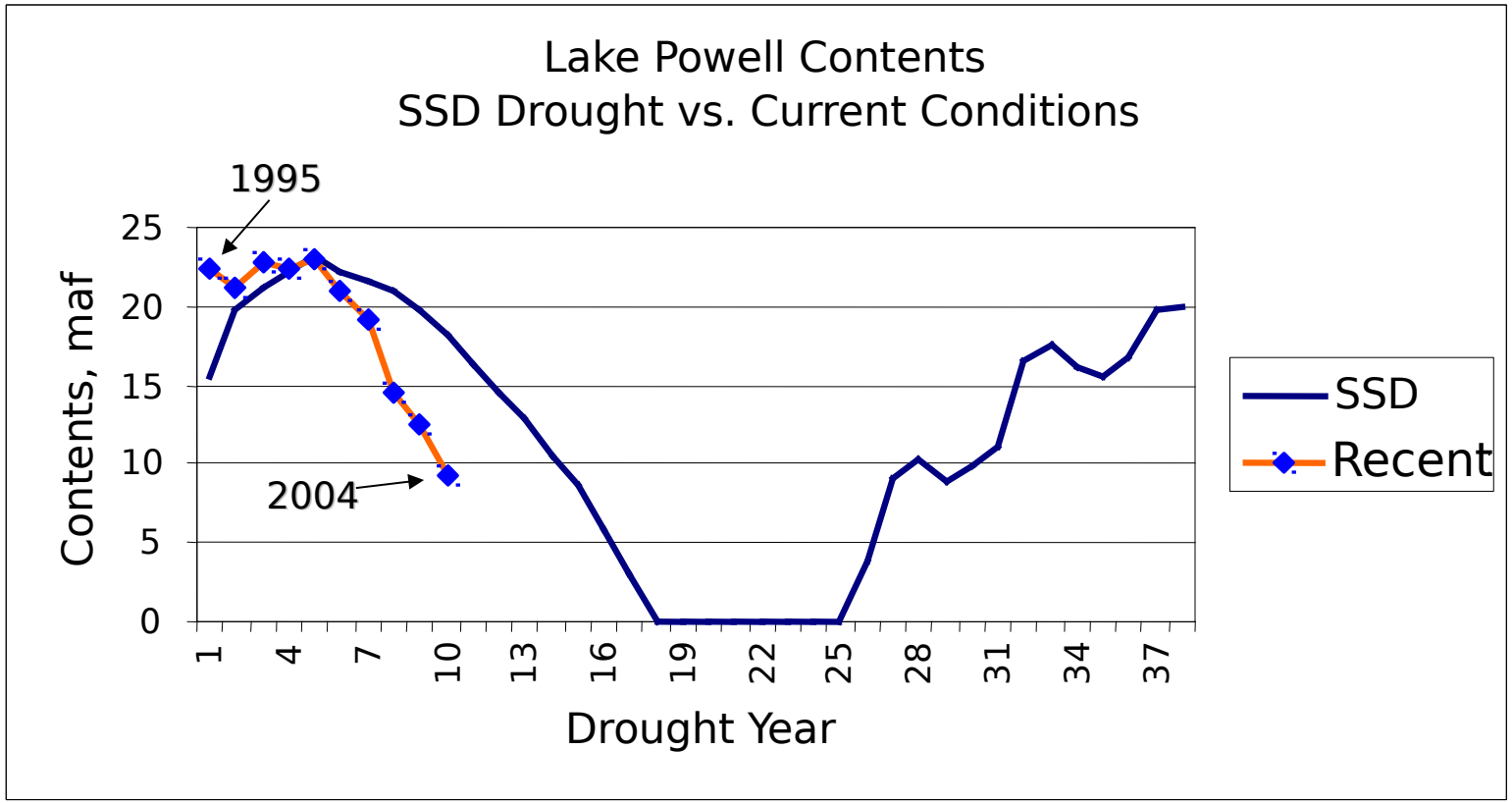


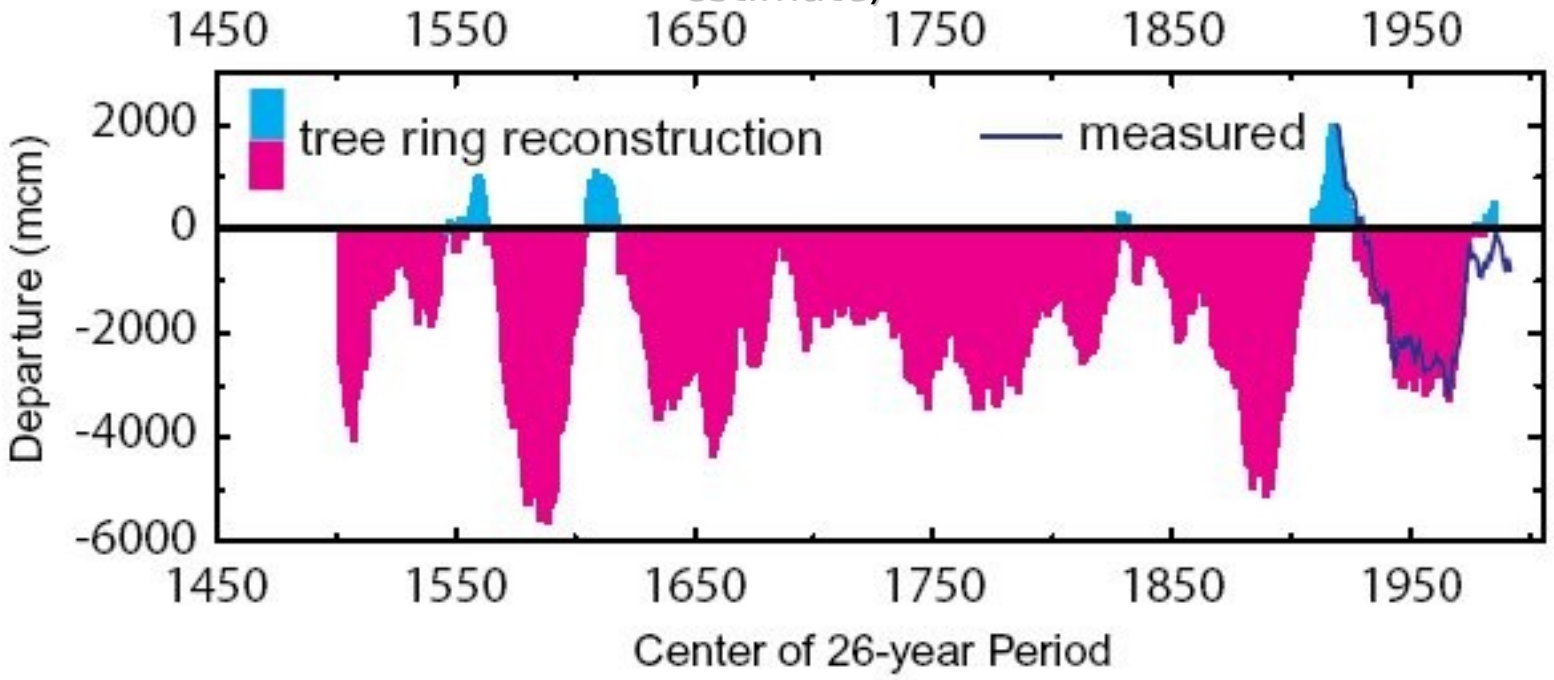
Based on 1579-1616 reconstruction of flow at Lees Ferry (1579-1600 drought, 1601-1616 recovery), 1992 water use.

Harding et al., WRB, 1995

USGS

The period used to estimate UCRB flows for the Colorado Compact was wet relative to other periods in the 20th century, as well as to most other periods during the past 500 years.

26-year moving average UCRB flow expressed as departures from the mean flow for 1896-1921 (the period used for the Colorado Compact mean flow estimate)



Tree ring reconstruction from Woodhouse et al., WRR, 2006.

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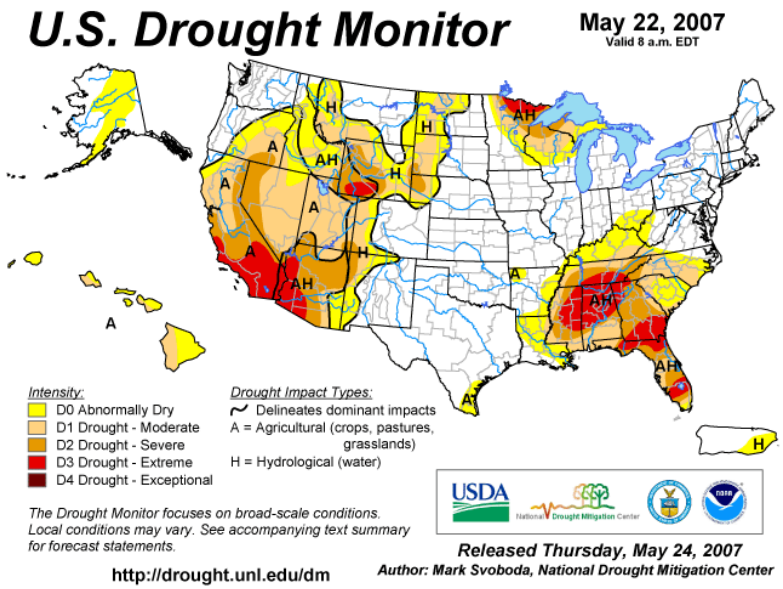
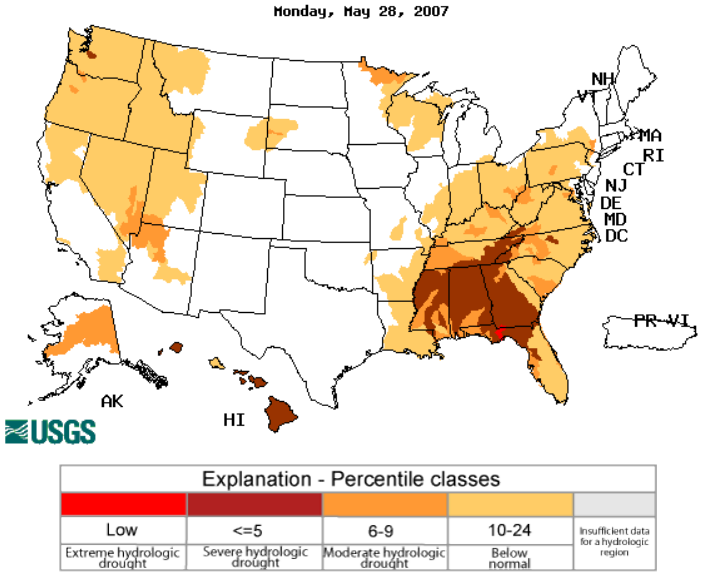
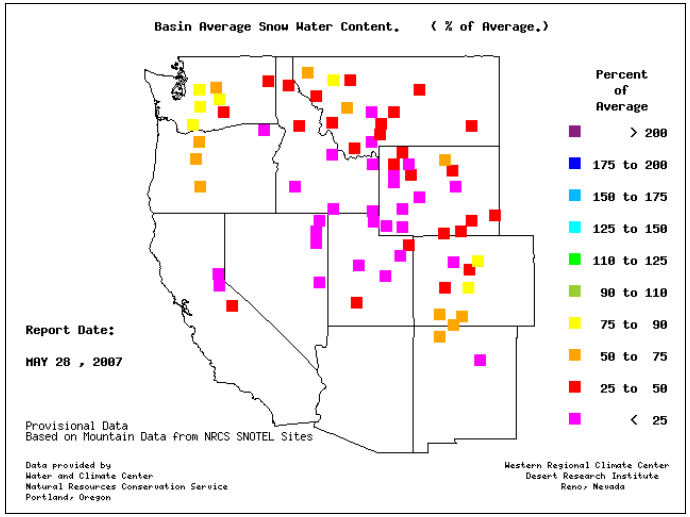
Hydrologic Conditions May 2007


U.S. Drought Monitor
May 22, 2007
Valid 8 a.m. EDT
Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
Released Thursday, May 24, 2007
Author: Mark Svoboda, National Drought Mitigation Center

Map of below normal 14-day average streamflow compared to historical streamflow for the day of year (United States)





USGS

Summary

- Droughts have significant climatic as well as socio-economic impacts.

- Since the end of the little Ice Age drought occurrence in the western US appears to have increased. Will this trend continue?

- Persistent US drought may be linked with persistently cool eastern tropical SSTs and warm North Atlantic SSTs.

- Climatic variability and change, as well as increased consumptive use of water resources may lead to future water supply problems in the UCRB.

USGS